

**Technical Report 15-003**

**Group Selection Methods and Contribution to the  
West Point Leadership Development System (WPLDS)**

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**United States Military Academy  
Network Science Center**

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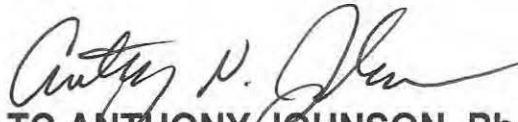


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# Group Selection Methods and Contribution to the West Point Leadership Development System (WPLDS)

Andrew C. Lee

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## ABSTRACT

Group work in an academic setting can consist of projects or problems students can work on collaboratively. Although pedagogical studies have shown the potential benefits of group work for learning, not a lot of studies examine which group selection method is best for certain types of learning. At the U.S. Military Academy, Cadets are not only expected to graduate as adaptive leaders, but also as individuals who can communicate and interact effectively in diverse settings as outlined in the West Point Leadership Development System (WPLDS). The main objective of this study was to determine which group selection method enabled Cadets to practice and refine their communication and interpersonal skills. Three group selection methods were investigated using a short survey in a sophomore level math course: self-selection by students, selection using a measure of academic and geographic proximity, and random selection by the instructor. The data suggests a distinct advantage for Cadets in gaining confidence to work with others if the instructor uses geographic and academic proximity to select project partners.

**Keywords:** *Group Selection Method; West Point; WPLDS; student groups; project partners*

## INTRODUCTION

Most of the supporters of group work in post-secondary education emphasize its importance in helping students develop intangibles like communication, time management, organization, leadership, interpersonal, and relationship skills. Supporting students enjoy the prospects of a lighter work load while supporting instructors benefit from less grading as well as the ability to inject more complex problems into the curriculum. Furthermore, group work also has the propensity to stimulate creativity. Meanwhile, critics of group work typically highlight the potential of free-riding, unequal work distribution, increased time consumption,

and the potential hazards of interpersonal conflicts. At the U.S. Military Academy (USMA), group work provides another opportunity to meet the Chief of Staff of the Army (CSA)'s strategic priority in developing adaptive leaders to solve complex problems while learning to work with different personalities. Most senior Army leaders would most likely rank the ability to work effectively in groups as one of the more important traits for a West Point graduate. One of the West Point Leader Development System (WPLDS) outcomes is *to communicate and interact effectively*. Three of the main ways instructors form groups in a classroom setting include: student choice, ability based groups, and random groups. This study explores the question: Which group selection method maximizes contribution to learning from both the academic and intangible skills perspective? Additionally, which selection method routinely provides the right crucible to develop capable future Army leaders at USMA?

## GROUP SELECTION METHODS AND THE WPLDS

While there are many different ways to form student groups, this paper focuses on three methods used in the Department of Mathematical Sciences in MA205 Integral Calculus and Introduction to Differential Equations in the fall of 2014. The most common method, student choice, allows the instructor to put the responsibility on the students to form their own groups. Yet this typically results in conservative choices with acquaintances or classroom neighbors to minimize adverse risk to their grades and also undesirably leaves the last few to be forced into groups. This can contribute to a feeling of isolation for the remaining students who are not chosen initially. On the other hand, given the short duration of time allotted for group projects each semester, self-selection can alleviate the requirement of gaining a productive level of comfort. Second, instructors choose groups arbitrarily using either a pseudorandom number generator or having students count off numbers to form groups. This method often results in students pairing up with others who they might know little about and can cause some initial discomfort. The advantages of random assignment are that it presents an appearance of fairness and it also reflects the real life work environment. Finally, instructors in MA205 also used student administration information, specifically company-regiment information and cumulative academic grade point averages to form groups. This allowed instructors to assign groups based on two different measures of closeness: geographic and academic proximity. The rationale for this method rests in assuming that students located closer to each other will meet more often face to face. The instructors who chose to select groups using this method paired students first using academic grade point averages and then also factored in the Cadets' company, building, or regiment.

The West Point Leader Development System (WPLDS) details several outcomes that Cadets should attain upon graduation. One of these outcomes, *to communicate and interact effectively*, states that "graduates communicate clearly, candidly, and confidently in diverse

settings using suitable means” [11]. In summary, this outcome describes a successful West Point graduate as someone who is considerate of others, actively listens, and clearly conveys information using all means of communication, all while being sensitive to customs, cultures, and courtesies. Measuring how well a Cadet achieved this outcome can prove difficult, but instructors can set the right environment in class to promote these behaviors and habits. This paper will determine if group selection methods can also assist the instructor in developing the Cadets’ communication and interaction skills. Group work in class can act as the right crucible for developing this particular WPLDS outcome.

## LITERATURE REVIEW

As one of the first articles to broach this topic of student group selection, Fiechtner and Davis proposed that students were more likely to report a positive experience when groups were formed by the instructor, who chose groups either randomly or selecting based their students’ attributes. The authors were also strongly against students self selecting their own groups [7]. Bacon et al. on the other hand concluded just the opposite, arguing that self-selected groups reported positive group experiences versus randomly assigned groups [2]. Yet both of these studies used nonexperimental designs in their research. Based on their research, Hinds et al concluded that if allowed to self-select group members, people are naturally biased towards predictability, choosing those of the same race or similarity, those who are reputed to be competent, and those who they have worked with in the past with success. Their data, which followed 33 software development groups of 3 to 7 members over a four year time span, revealed the highest statistical significance in choosing groups based on indicators or reputation of competence. Lazarsfeld and Merton (1954) coined the term homophily to refer to how people tend to gravitate towards others with similar attitudes, beliefs, and characteristics [10]. In addition, Hinds et al hypothesized that people choose group partners who have skill sets instrumental to the task and whose skills complement their own. Other researchers reached similar conclusions. Self selected groups tend to gravitate towards friends and roommates, which can result in more time socializing than actual group work [5]. Schneider argued that organizations left to their own devices will continue to recruit others that are similar until homogeneity is reached [10].

The advantages of diversity include flexibility, adaptiveness, and innovativeness. In 2001, Felder and Brent’s research suggested that groups which are assigned by the instructor tend to perform better than self selected groups. Additionally, Hilton and Phillips argue that a very important achievement by students from instructor formed groups is learning to trust peers they are unfamiliar with. They view the development of trust as a “superior outcome to the comparatively less challenging experience of maintaining the trust that already existed within student-selected groups” [9].



Most of the current research delving into the topic of group selection use anecdotal evidence to support one method of selection over another, and those that do present empirical evidence are focused only on a few group selection methods. Bachmann's research concluded that an individual's learning style, whether they are visual learners, auditory learners, or tactile learners, should be used to choose project partners [1]. This paper will seek answers for the following questions using a wide range of empirical evidence on three group selection methods: Self selection, academic and geographic proximity selection, and random selection:

1. Group homogeneity: Are Cadets more likely to choose someone similar to them if self-selecting?
2. Which method of group selection offers the Cadets more opportunity to gain confidence in learning how to work with just about anyone?
3. Which method of group selection can teach the Cadets more intangibles?
4. Does one method of group selection have more to contribute to the "Communicate and Interact Effectively" outcome than other methods?

## **METHOD OF DATA COLLECTION**

Although this was the first project in MA205, we can assume that students had some rough assessment of peer competency and skill sets if they selected their own groups from observation in the class and prior knowledge. The Cadets in MA205 completed a 20 question survey on a Sharepoint site focused on the questions listed above. The survey predominantly used a five point Likert scale, with 1 equivalent to strongly disagree and 5 equivalent to strongly agree. The survey was timed through Sharepoint and any Cadet who took shorter than 1 minute to complete was not included in the analysis based on the assumption that he or she rushed through the survey. In addition, those Cadets who worked individually on the projects were not included in the data. In all, there were 111 students who self selected their project partner, 73 students who were paired by their instructors based on geographic and academic proximity, and 40 students who were randomly paired. The actual survey can be found in Appendix A but the select few that this paper focuses on are listed in Table 1 along with the variable name used:

Variable Name Used	Survey Question
Learned_intangibles	I would say that I learned a lot of intangible lessons (i.e. leadership, problem solving, communication, interpersonal skills, social skills, time management) from completing this project
Confidence_work_anyone	After completing this project, I feel more confident that I can work successfully with ANYONE
Familiarity	How familiar were you with your partner prior to the project? (1- unfamiliar to 5-familiar)
Partner_like_me	I felt as though my assigned partner was more like me than other students in the class.
Enjoyed_team	I fully enjoyed the teamwork and experience in completing this project
Grade_partner	If you could, what grade would you give your partner for his/her work? (this will be anonymous) (1 – F, 5 – A)
Diff_Hrs	Difference between the questions: How many total hours did YOU as an individual put into this project? As a best estimate, how many hours do you think your PARTNER put into this project?
Learned_course	I would say that I learned a lot about the course material from completing this project

**Table 1: Select Predictor Variables from the survey along with the actual survey question.**

A critical assumption is that the students' group project experience is not defined by who they have as an instructor; in other words, the 15 instructors who took part in the survey will not significantly impact how the Cadets answer the survey questions. It is also important to recognize that despite all of the different group selection methods, the lines between them will be blurred. For example, even a randomly selected pairing will result in students paired with close friends given the fact that this was a sophomore class. Likewise, a self-selected group could have also been close in academic cumulative grade point averages and geographic proximity.

## ANALYSIS AND RESULTS

Besides the expected significant correlations ( $>.70$ ) between variables that measured cohesiveness, synergy, and skill complements, the **Learned\_Intangibles** variable has a moderately positive relationship with the **Confidence\_work\_anyone** variable (with a correlation coefficient of .47). Furthermore, the **Learned\_Intangibles** variable also exhibits a moderately positive relationship (with a correlation coefficient of .57) to the **Enjoyed\_team** variable. The mean responses to the group dynamic measures based on the group selection methods can highlight some of the initial findings from the survey. A summary of the mean can be found in Table 2.

Group Method vs variables	Self Selected	Geographic/Academic Proximity	Randomly paired
Learned_intangibles	2.657	2.890	2.850
Confidence_work_anyone	3.054	3.479	3.125
Familiarity	3.621	3.068	3.350
Partner_like_me	3.333	2.849	3.175
Enjoyed_team	2.657	3.054	2.975
Grade_partner	4.216	4.287	4.500
Diff_Hrs	1.253	1.535	.8125
Learned_course	2.964	3.301	3.125

**Table 2: Summary of the mean responses to group dynamic measures based on group selection methods**

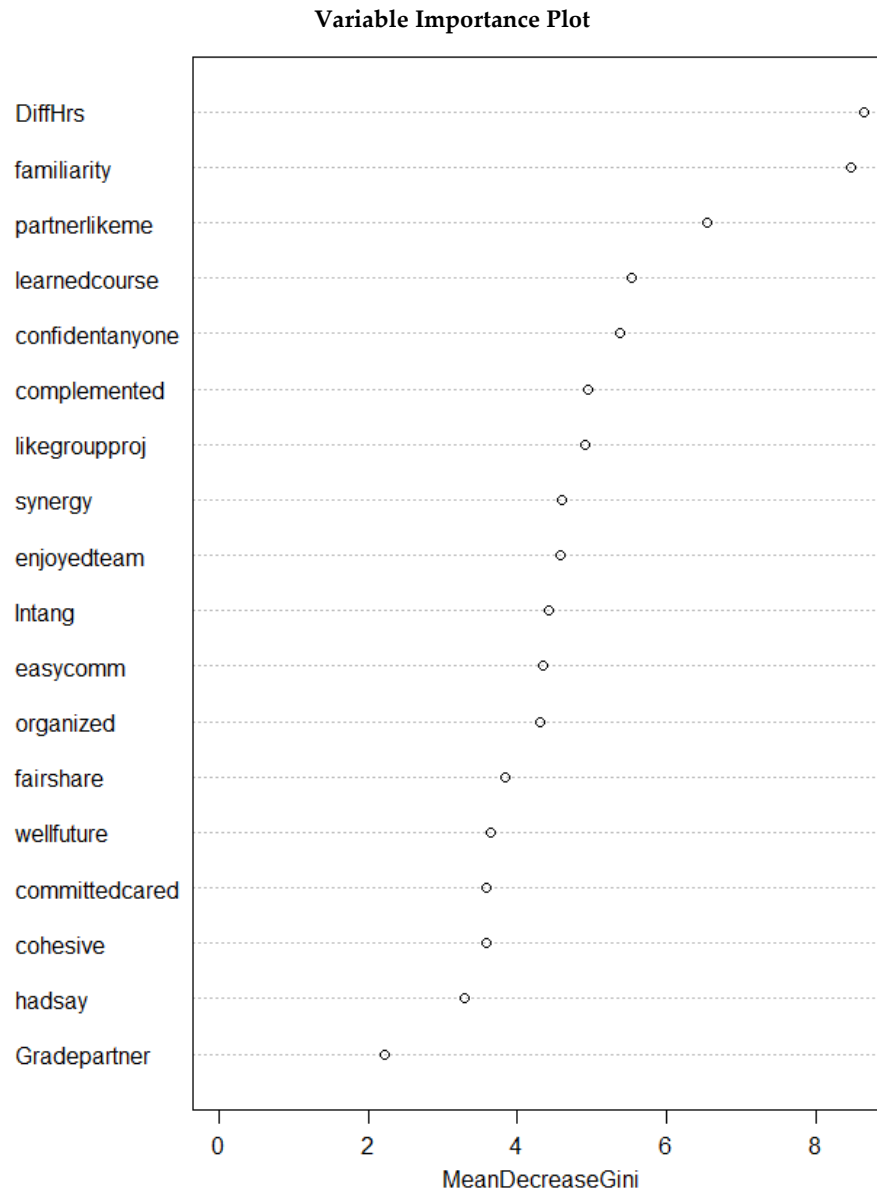
From Table 1, it appears that selection methods based on geographic and academic proximity contributed the most to the intangibles mentioned in the communicate and interact effectively outcome of the WPLDS. It also seems to make logical sense that when Cadets are paired with those that they are less familiar with, it helps build confidence in their ability to work successfully with anyone. With familiarity, the data reflects the assumption that self-selected groups are likely to be formed amongst friends and/or acquaintances. In addition, the data presents evidence of group homogeneity and homophily as detailed by Hinds for the self-selected groups. Interestingly, the overall enjoyment measure of the project experience was lowest with self-selected groups and highest with the groups selected based on geographic and academic proximity. Notional grades given to the partners were highest with the groups based on random selection, and lowest with the self-selected groups. The difference between what the Cadets reported as the hours they put in minus the hours they thought their partner put in was highest with the proximity group and lowest with the random selection groups. Finally, the proximity group also received the highest ratings from Cadets who thought they learned a lot about the course material from the project.

Due to the small sample size for the random selection method, we next performed a two sample t-test assuming unequal variances focused only on the self-selected groups compared to the academic proximity groups. Table 3 summarizes the results of these hypothesis tests. For example, to determine if there is a higher rating on familiarity with the self-selected groups compared to the academic proximity method, the two sample t-test results in a p-value of .0046. This shows significant evidence that Cadets in general will select partners who they are familiar with if given the option to self-select. The measures for the WPLDS communicate and interact effectively outcome are statistically significant, more evidence that group selection methods can induce learning intangible lessons and increase confidence in working with less familiar students. The only measures that were not statistically significant were the notional grades given to partners and the difference in hours of work.

	Self Selected	Geographic/Academic Proximity	p-value Hypotheses tested
Learned_intangibles	2.657	2.890	.0687 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$
Confidence_work_anyone	3.054	3.479	.0041 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$
Familiarity	3.621	3.068	.0046 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P > 0$
Partner_like_me	3.333	2.849	.0045 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P > 0$
Enjoyed_team	2.657	3.054	.0642 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$
Grade_partner	4.216	4.287	.3336 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$
Diff_Hrs	1.253	1.535	.312 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$
Learned_course	2.964	3.301	.0262 $H_0: \mu_S - \mu_P = 0$ $H_a: \mu_S - \mu_P < 0$

**Table 3: Results of 2 sample t-tests and p-values. For the hypotheses,  $\mu_S$  represents the mean from the self-selected groups, and  $\mu_P$  represents the mean from the proximity groups.**

To further determine which variables were most important in predicting the group selection method, a Random Forest analysis was conducted in R. Random Forests, another version of classification trees, use out of bag data to determine an unbiased estimate of the classification error as additional trees are added. R provides a variable importance plot as shown below that measures Gini importance. Gini is defined as inequity or dispersion when used in describing a society's distribution of income. In R, a higher decrease in Gini means that a certain predictor variable plays a larger role in partitioning the data into the two classes. Every time a split of a node is made on variable  $m$ , Figure 1 illustrates the summation of all of the Gini decreases for  $m$  over all trees in the forest. It appears that **Diff\_Hrs**, **Familiarity**, **Partner\_like\_me**, **Learned\_course**, and **Confident\_work\_anyone** were most important to distinguishing between the self-select and proximity group selection methods.



**Figure 1: Variable Importance Plot from R showing mean decrease in Gini. The top five more important variables appear to be Diff\_Hrs, Familiarity, Partner\_like\_me, Learned\_course, and Confident\_work\_anyone**

Given the five important predictor variables given by Random Forest analysis, a logistic regression analysis was performed using R statistical software to model the log odds of the group selection method modeled as a linear combination of these variables. The response variable is a binary variable with 1 being self-selected groups and 0 being geographic/academic proximity groups. Note that three of the predictor variables are focused on the indicators of the WPLDS communicate and interact effectively outcome: **Confident\_work\_anyone, Familiarity, and Partner\_Like\_Me.**

Coefficients:	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	0.69085	0.84022	0.822	0.411
Confident_work_anyone	-0.34168	0.17392	-1.965	0.0495*
Learned_course	-0.27566	0.15441	-1.785	0.0742*
Partner_like_me	0.25852	0.17755	1.456	0.1454
DiffHrs	0.03323	0.04488	0.74	0.459
Familiarity	0.25693	0.12854	1.999	0.0456*

Figure 2: Logistic Regression output. The variables **Confidence\_work\_anyone**, **Learned\_course**, and **Familiarity** are statistically significant to predicting the group selection method.

After removing the variables one at a time according to p-values, the predictor variables **Confidence\_work\_anyone**, **Learned\_course**, and **Familiarity** remain statistically significant. Figure 3 shows the logistic regression output for these select variables.

Coefficients:	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	1.3577	0.7076	1.919	0.05502
confidentanyone	-0.3679	0.1712	-2.149	0.03165*
learnedcourse	-0.2509	0.1504	-1.668	0.09533*
familiarity	0.314	0.1137	2.761	0.00577*

Figure 3: Refined logistic regression output using only the three statistically significant variables.

The logistic regression coefficients give the change in the log odds of the outcome for a one unit increase in the predictor variable. In this case, for every one unit change in the variable **Confidence\_work\_anyone**, the log odds of the group selection method being a 1 or the self-select group decreases by .3679, providing further evidence that the level of confidence gained from the project is related to the group selection method, in this case attributed to the geographic/academic proximity method. For a one unit increase in the variable **Learned\_Course**, the log odds of the group selection method being the self-select group decreases by .2509. Finally, for a one unit increase in the variable **Familiarity**, the log odds of the group selection being the self select group increases by .314. Therefore, one model that could predict what group selection method you chose could be described using these three statistically significant variables.

$$\text{Log} \left( \frac{p(x)}{1-p(x)} \right) = 1.3577 - .3679 \cdot \text{Confident\_work\_anyone} - .2509 \cdot \text{Learned\_course} + .314 \cdot \text{Familiarity}$$

A chi-squared test analysis of deviance shows an overall reduction in deviance from 247.17 to 227.45 on 5 degrees of freedom for a p-value of 0.00141. This supports the model and shows a significant reduction in deviance from the null model.

## CONCLUSION

At the U.S. Military Academy, not only do military science classes and summer training events teach Cadets how to develop leadership traits outlined in the West Point Leadership Development System, academic instructors can also make a significant impact by choosing the right techniques in the classroom. This research paper focused on the “Communicate and Interact Effectively” outcome from WPLDS and in particular studied the effects of group selection methods on different measures of this outcome. Although Cadets in general seem to prefer self-selection of their own project partners, the data from a survey of MA205 Cadets shows that Cadets are missing out on an important developmental opportunity to gain confidence in working outside of their comfort zone. Most Cadets self-selecting their own project partners choose someone similar to themselves in culture, beliefs, and attitudes; however, this diverges from Cadets learning how to “communicate clearly, candidly, and confidently in diverse settings” as outlined in the WPLDS. Furthermore, the sample data also shows evidence that the overall enjoyment measure as well as learning coursework from the project experience is lower with self-selected groups and highest with the groups selected based on geographic and academic proximity. The classroom environment and group projects in particular are well suited to develop communication, interpersonal skills, trust, and social skills for the Cadets. This sample data reveals a distinct advantage in Cadets gaining confidence in unfamiliar settings if the instructor uses geographic and academic proximity to select groups as opposed to allowing Cadets to self-select.

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## **APPENDIX A: Survey Questions**

How many total hours did YOU as an individual put into this project?

As a best estimate, how many hours do you think your PARTNER put into this project?

If you could, what grade would you give your partner for his/her work? (this will be anonymous)

I fully enjoyed the teamwork and experience in completing this project

I would say that I learned a lot of intangible lessons (i.e. leadership, problem solving, communication, interpersonal skills, social skills, time management) from completing this project.

I would say that I learned a lot about the course material from completing this project

After completing this project, I feel more confident that I can work successfully with ANYONE

It was easy to communicate and coordinate with my partner

I felt as though we were organized with this project

I felt as though we each had a say in how we completed the project and in the decision making

I felt as though we both did our fair share of the work on this project

My team was more productive than I would have been as an individual

My team was cohesive; we pushed each other through encouragement and cooperation

I am confident that this same team can perform effectively with other future projects

My partner was fully committed and cared about completing the project

My partner's skills and abilities complemented my own

In general, I am the type of person that likes group projects

I felt as though my assigned partner was more like me than other students in the class

How familiar were you with your partner prior to the project?